

Descriptions of the Immature Stages of *Delphacodes bellicosa* (Homoptera: Fulgoroidea: Delphacidae)

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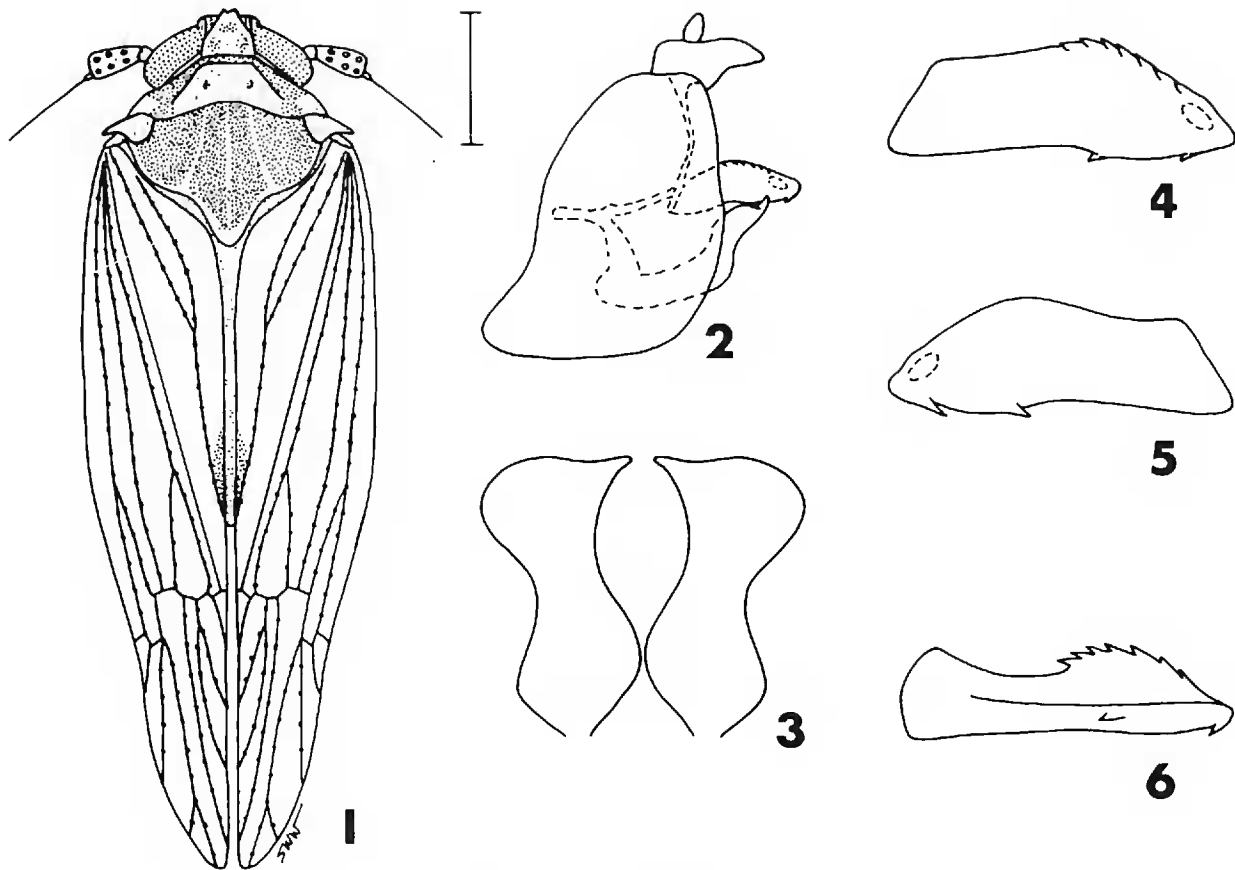
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Abstract.—The immature stages of *Delphacodes bellicosa* Muir and Giffard are described and illustrated. Features useful in separating nymphal instars include the number of metatarsal segments, the size, shape, and dentation of the metatibial spur, the increase in body size, wingpad size, and number of pits. Eggs of *D. bellicosa* were found inserted in stems and nymphs and adults were observed feeding on leaves of knotgrass (*Paspalum distichum* L.)

Delphacodes bellicosa Muir and Giffard (1924) is known only from the male holotype collected at Three Rivers, Tulare Co., California. On 17 May 1981 I collected 3 males of this species at a manmade lake in Bidwell Park, Chico, Butte Co., California. Identity of females collected is questionable because two other *Delphacodes*, *D. consimilis* (Van Duzee) and *D. foveata* (Van Duzee) were also collected at the lake.

On 20 May 1981 an adult male *D. bellicosa* was observed feeding on the leaves of knotgrass (*Paspalum distichum* L.). Ten plants were returned to the laboratory and 52 eggs were found inserted in one stem; 10 of these were preserved in 95% ethyl alcohol and the remaining eggs removed from the surrounding plant tissue with a fine needle and placed on a strip of filter paper. The strip was placed in a petri dish that was covered on the bottom with a disc of moistened filter paper. The dish was covered with plastic secured with an elastic band and covered with the lid; the plastic prevented newly hatched nymphs from escaping between the dish and lid. Upon hatching, the nymphs were provided with a cutting of knotgrass leaf added to the dish and replaced every three to four days. The dish was kept in an incubator under a 16L:8D photoperiod at $29 \pm 1.4^\circ\text{C}$. All of the eggs hatched. Because 12 of the 1st instars died within a few days of hatching (apparently by drowning in the condensation on the walls and plastic cover of the dish), the remaining nymphs were transferred to knotgrass that had been planted in a clay pot; this knotgrass was collected at the same locality and carefully examined for eggs before transplanting. The pot was covered with a glass cylinder and covered with a piece of fine mesh gauze secured with an elastic band. The potted knotgrass was kept in a greenhouse.

In order to obtain specimens for description several nymphs were collected from the potted plant each week until the emergence of 3 adult males. Specimens to be described were preserved in 95% ethyl alcohol. The first instar is described in detail but only major changes from previous instars are described for subsequent instars. Comparative statements refer to previous instars (e.g., more elongated).



Figures 1–6. *Delphacodes bellicosa* Muir and Giffard. 1. Habitus of male macropter, vertical bar = 0.5 mm. Male genitalia. 2. Complete left lateral view. 3. Styles in caudal view. 4. Aedeagus in left lateral view. 5. Aedeagus in right lateral view. 6. Aedeagus in ventral view.

Dimensions of eggs and nymphs are expressed in millimeters as mean \pm SE. For nymphs, length was measured from tip of vertex to tip of abdomen; width was measured across the widest part of the body. Thoracic length was measured along the midline from the anterior margin of the pronotum to the posterior margin of the metanotum.

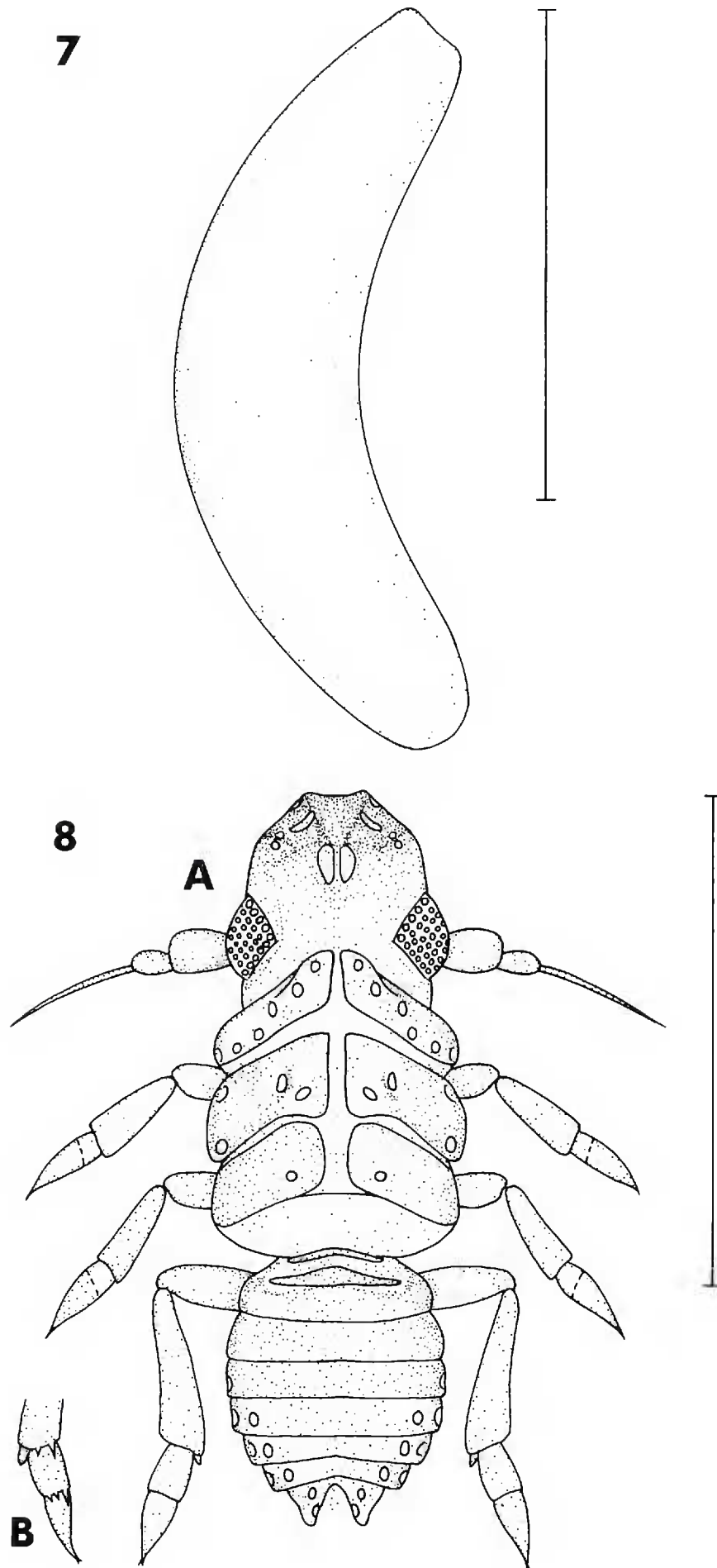
Adult (Figs. 1–6).—Muir and Giffard (1924) described an adult male brachypter and provided illustrations of the aedeagus. An adult male macropter is illustrated in Figure 1 and male genitalia in Figures 2–6. Collecting data for all specimens are: CALIFORNIA: Butte Co., Chico, 17 May 1981 (3 δ), 20 May 1981 (11 δ ; plus 3 δ “collected as eggs, greenhouse reared”), 27 May 1981 (4 δ), 1 June 1981 (1 δ).

Egg (Fig. 7).—Length 0.76 ± 0.007 ; width 0.19 ± 0.003 ; 10 specimens examined. Eggs laid singly; each elongated, curved, subconical, narrowing at ends, anterior end blunt, posterior end broadly rounded; white; chorion translucent, smooth.

First instar (Fig. 8).—Length 0.76 ± 0.015 ; thoracic length 0.24 ± 0.005 ; width 0.26 ± 0.003 ; 9 specimens examined.

Form elongated, subcylindrical, widest across mesothorax. Body pale brownish.

Vertex subquadrate, anterior margin barely discernible, extending to or beyond level of anterior margin of eye. Frons convex and broadly rounded in lateral view; in frontal view, ovoid, about as wide as long, widest about midway from vertex to clypeal border; lateral margins convex, ventral margin concave, each lateral margin carinate (outer carina) and paralleled by a second carina (inner carina), which originates near anterior border of vertex and extends ventrally to clypeal border; 9 pits in 2 irregular rows between each inner and outer carina and 2 pits



Figures 7, 8. Immature stages of *D. bellicosa*. 7. Egg. 8. 1st instar. A. Nymph, B. Ventral view of distal end of metathoracic leg. Vertical bar = 0.5 mm.

between outer carina and eye. Clypeus narrowing distally, consisting of basal postclypeus and cylindrical distal anteclypeus. Beak 3-segmented, extending to metacoxae; segment 1 almost obscured by anteclypeus, segments 2 and 3 subequal. Eyes red. Antennae 3-segmented; scape ring-like, short; pedicel subcylindrical,

ca. $3 \times$ longer than scape; flagellum bulbous basally, filamentous distally, bulbous portion ca. $\frac{2}{3}$ to $\frac{3}{4}$ length of pedicel.

Thoracic nota divided by a longitudinal middorsal line into 3 pairs of plates. Pronotum longest laterally, extending anteriorly to or beyond posterior margin of eye; each plate subrectangular, posterior margin slightly sinuate, with a short, oblique, sinuate carina extending posterolaterally from anteromedial corner; with a single row of 6 pits. Mesonotum with median length slightly longer than that of pronotum; each plate subquadrate, posterolateral margin convex, with 2 pits in median half and 2 pits near lateral margin. Metanotum with median length slightly shorter than that of mesonotum; each plate subquadrate, with 1 pit in posteromedial corner. Pro- and mesocoxae elongated, posteromedially directed; metacoxae smaller, obscured by cup-like trochanters. Metatibiae with 2 black-tipped spines apically and a very short, moveable, conical, spikelike spur; spur subequal in length to longest spine. Tarsi 2-segmented, divisions between tarsomeres very obscure; pro- and mesotarsomere 1 somewhat wedge-shaped, metatarsomere 1 with a row of 3 black-tipped spines apically; segment 2 of all legs subconical, slightly curved, with a pair of slender apical claws.

Abdomen 9-segmented, subcylindrical, widest across segments 4 and 5; segment 9 elongated vertically, surrounding anus. Segments 1 and 2 with tergites reduced to obscure plates; each segment with the following number of pits on either side of midline (lateralmost and caudal pits often not visible in dorsal view): segment 5 with 1 lateral pit on tergite, segments 6–8 each with 2 lateral pits on tergites, segment 9 with 3 caudal pits.

Second instar (Fig. 9).—Length 0.87 ± 0.003 ; thoracic length 0.29 ± 0.007 ; width 0.39 ± 0.007 ; 3 specimens examined.

Body slightly dorsoventrally flattened.

Vertex subpentagonal. Frons with 3 pits between each outer carina and eye. Antennae with pedicel bearing 2 ring-like sensoria on dorsal aspect near apex; flagellum with bulbous portion ca. $\frac{1}{2}$ length of pedicel.

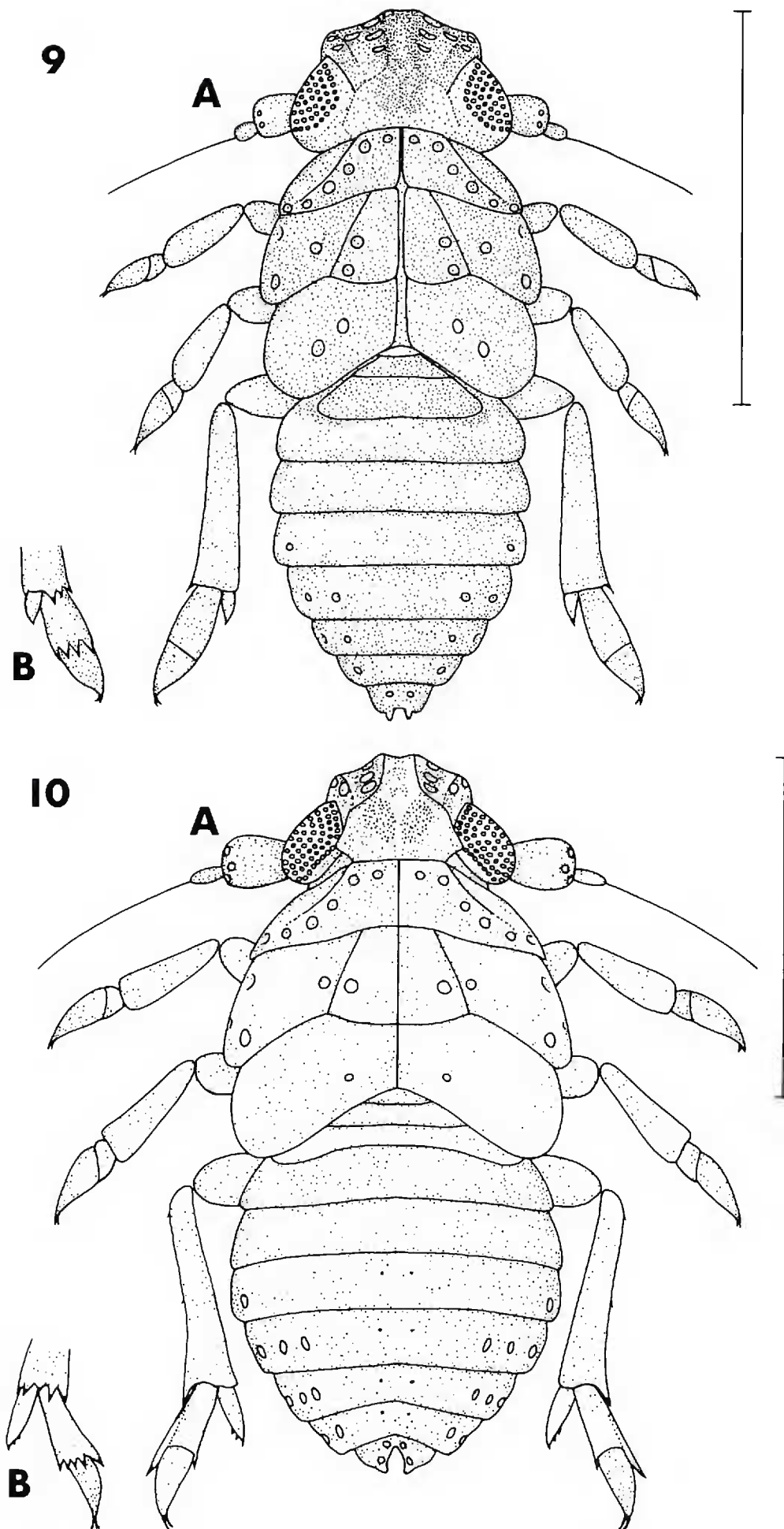
Mesonotum with each plate bearing an oblique carina originating on anterior margin ca. $\frac{1}{3}$ distance from midline to lateral margin and extending posterolaterally to posterior margin of mesonotum; with 2 pits between midline and oblique carina and ca. 3 pits between oblique carina and lateral margin. Metanotum with each plate bearing 2 pits. Metatibiae bearing 3 black-tipped spines apically; spur $2 \times$ or more length of longest spine. Tarsi with divisions between tarsomeres distinct; metatarsomere 1 with a row of 4 black-tipped spines apically.

Third instar (Fig. 10).—Length 1.03 ± 0.027 ; thoracic length 0.36 ± 0.007 ; width 0.46 ± 0.009 ; 10 specimens examined.

Frons, in lateral view, convex and broadly rounded dorsally but nearly straight vertically. Antennae with pedicel bearing 4 sensoria; flagellum with bulbous portion ca. $\frac{1}{3}$ length of pedicel.

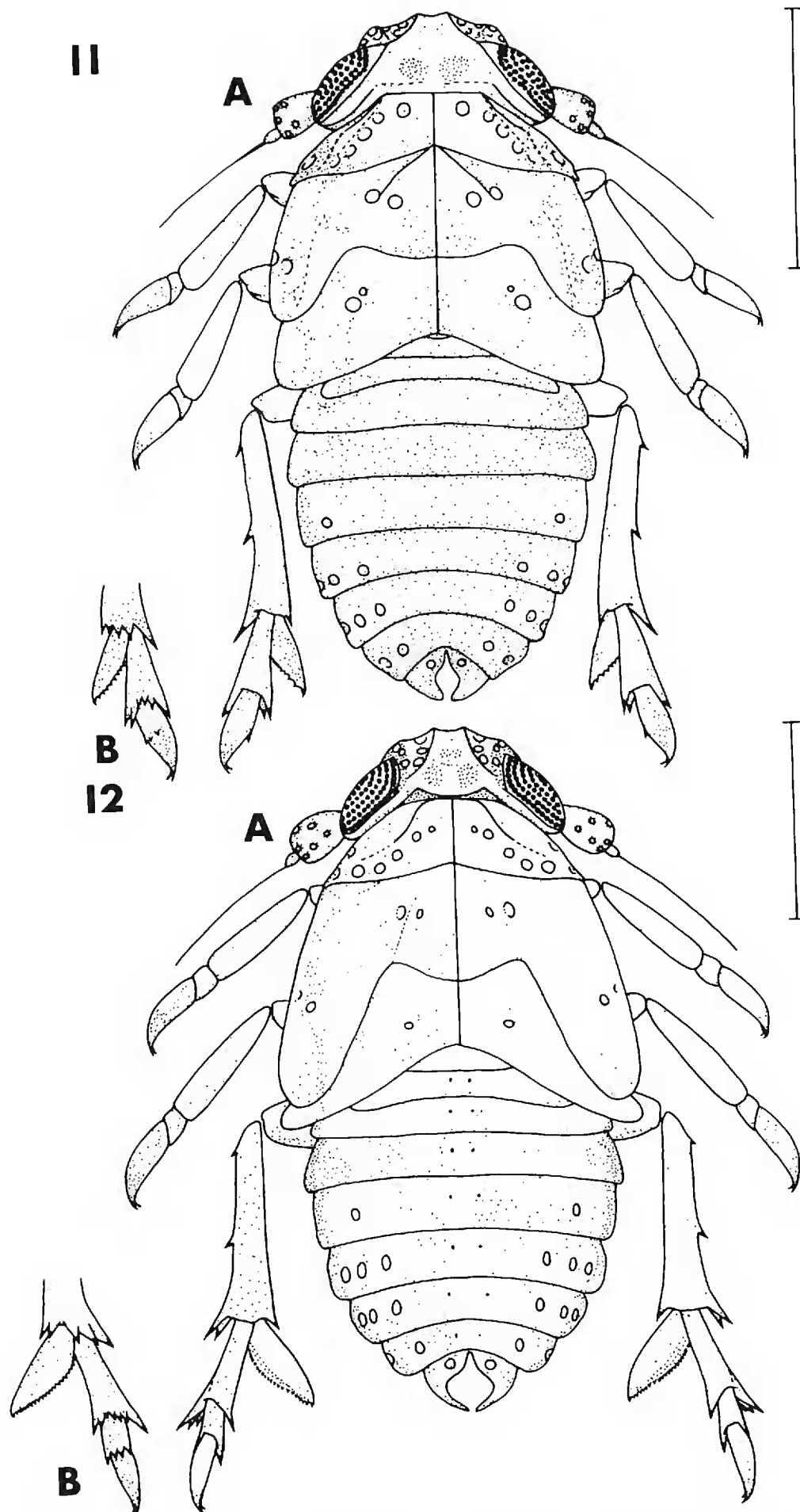
Mesonotum with wingpads slightly lobate. Metanotum with each plate apparently bearing 1 pit. Metatibiae with 2 small black-tipped spines on lateral margin, 1 near base and 1 in basal $\frac{1}{3}$ to $\frac{1}{2}$ and a row of 5 black-tipped spines apically; spur somewhat flattened, more elongated, with 2–3 very small black-tipped teeth just before apex and 1 tooth at apex. Metatarsomere 1 with a row of 5 black-tipped spines apically.

Abdominal tergites with the following number of pits on either side of midline



Figures 9, 10. Immature stages of *D. bellicosa*. 2nd instar. 10. 3rd instar. A. Nymph, B. Ventral view of distal end of metathoracic leg. Vertical bar = 0.5 mm.

(lateralmost and caudal pits often not visible in dorsal view): segment 5 with 1 lateral pit on tergite, segments 6–8 each with 2 lateral pits on tergite, segment 9 with 3 caudal pits.



Figures 11, 12. Immature stages of *D. bellicosa*. 11. 4th instar. 12. 5th instar. A. Nymph, B. Ventral view of distal end of metathoracic leg. Vertical bar = 0.5 mm.

Fourth instar (Fig. 11).—Length 1.62 ± 0.063 ; thoracic length 0.52 ± 0.013 ; width 0.75 ± 0.043 ; 6 specimens examined.

Body pale with irregular light brown markings.

Frons with 4 pits between each outer carina and eye. Antennae with pedicel bearing 6 sensoria; bulbous portion of flagellum ca. $\frac{1}{4}$ length of pedicel.

Mesonotum with wingpads distinctly lobate, covering ca. $\frac{1}{2}$ of metanotal plate laterally. Metatibial spur elongate, more flattened, with a row of ca. 8 very small black-tipped teeth, spur extending almost to apex of tarsomere 1. Metatarsi with tarsomere 1 bearing a row of 6 black-tipped spines apically; tarsomere 2 with a row of 3 small black-tipped spines near middle partially subdividing tarsomere.

Fifth instar (Fig. 12).—Length 1.72 ± 0.087 ; thoracic length 0.57 ± 0.020 ; width 0.74 ± 0.025 ; 8 specimens examined.

Frons with length ca. $1\frac{1}{2} \times$ width. Antennae with pedicel bearing 9 sensoria; bulbous portion of flagellum ca. $\frac{1}{6}$ length of pedicel.

Pronotum with each plate bearing 7 pits. Mesonotum with wingpads extending to, or almost to, apex of metanotal wingpads laterally (specimens upon which this description is based are assumed to be macropters, brachypters would probably have mesonotal wingpads similar to those of 4th instars as in *Megamelus davisii* Van Duzee [see Wilson and McPherson, 1981]). Metatibial spur foliose, more elongated and flattened, with a row of ca. 15–21 very small black-tipped teeth. Metatarsi 3-segmented; tarsomere 1 with a row of 7 black-tipped spines apically; tarsomere 2 with a row of 4 black-tipped spines apically; tarsomere 3 similar to apical tarsomere of earlier instar.

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